Print ISSN: 1738-3110 / Online ISSN 2093-7717
JDS website: http://www.jds.or.kr/
http://dx.doi.org/10.15722/jds. 20.09.202209.11

Spending on Distribution Information and Communication Technologies and Cost-Effective Operation in Banks

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Received: June 13, 2022. Revised: June 29, 2022. Accepted: September 05, 2022.

Abstract

Purpose: Many concerns have appeared in banking sector in the digital era and one of them is that technology development will increase operation costs of banks. Motivated by this issue, our study aims to explore the effect of technological and digital investments on cost-effectiveness of banking operation. **Research design, data and methodology:** To reach a clear answer, we use the data of 12 commercial banks spanning from 2011 to 2020 in Vietnam and employ multivariate regression analysis as well as perform various robustness tests. **Results:** Our regression result indicates that the adverse effect of technological spending on cost-effective operation. This finding still remains unchanged when we conduct different robust tests. Also, we find that this negative impact becomes more evident in large banks than in small ones. **Conclusions:** The paper provides one of the most important empirical results for mangers and policy-makers in banking sphere, especially in Vietnam where regulators have been calling for continuously investing into technological innovation in banks. The evidence confirms that banks should carefully consider an increase in spending on distribution information and communication technologies when constructing business strategies related to expanding digitalization. Our research is also useful for countries having similar financial structure to Vietnam.

JEL Classification Codes: G21, G00, O31

Keywords: Distribution; Digitalization; Technology Development; Investment Strategy; Banking Operation Costs.

1. Introduction

These days, it is not exaggeration to affirm that the effect of development of technology has been reverberating across all socio-economic aspects over the world. Thus, easily understanding why it has received much attention from not only academics but also policy-makers as well as managers in recent years. And banking system, the backbone of an economy, becomes a vital area to explore this impact due to the fast changes in technology have reshaped the operation of traditional banks (Lee et al., 2021), which is transformed from "brick and mortar" into digitalized environment (Vives, 2019).

Even though the technological progress brings enormous benefits for banks, there are a variety of concerns about its adverse effect on banking operation. On the one hand, the emergence of new comers, Fintech firms, with the ability in providing new products and services at the lower cost, makes financial market become fierce competition (Vives, 2019). Hence, to survival in digital era, banks have to increasingly investing into technology regardless of whether these costs are really effectiveness (Uddin et al., 2020a). Furthermore, they must also face the risk of increasing cyber-security that may erode the trust of customers and lead

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to rise the operational costs due to banks cannot eliminate this hazard by continuously investing into technology alone (Uddin et al., 2020b). With that in mind, our study is carried out to answer the straightforward question of whether the persistent technological investments will help to improve the efficiency of operating costs in banking system or not. Based on the landscape of a developing country that Vietnam is the good sample, in general, our empirical analysis confirms the concern of Uddin et al. (2020b), who alarm that spending more on cyber-technology would lead banks to increase operation costs despite it may contribute to enhance their operating efficiency as the recent study of Phan et al. (2022) has indicated.

Vietnam provides one of pertinent laboratories for us to discover the relationship between increasing technological investments and effectiveness of operating costs in banking sector. First, Vietnam is seen as the emerging country relying on the development of banks to booster the economic growth (Tran, 2022). Therefore, every vulnerability of banking system will cause the instability of economy in this country. Moreover, in reality, Vietnam is seen as the country standing at the "good position" on the digital path and digitalization is expected to become the heart of financial market in particular and the growth of economy in general in coming future. At the same time, this nation has also become one of internet economies having the fasted rise in ASEAN region and the growth of e-commerce sales has been standing at the similar pace to that of world e-commerce sales and faster than that of GDP. In this vein, to compete on the global race, digital transformation is considered one of the center targets that Vietnamese government will pursue in doing National Development Strategy in next ten years. For banking sphere, State Bank of Vietnam has issued Decision 2617/QĐ-NHNN on the "Action plan of the banking industry to realize Directive 16/CT-TTG of the government on enhancing the nation's capability to embrace the 4th industrial revolution technologies by 2020 with the vision towards 2025" to support financial institutions in digitalization of banking products and services. One of the most important actions is that commercial banks will use at least 5% of total operation costs for IT infrastructure and equipment. This not only shows the ambitious purpose of Vietnamese regulators, but also, to some extent, may create significant pressure on the local banking system because a boom of spending on technological innovation in short time may decrease these effective investments. In fact, one of Vietnamese modern banks – TPBank - always having technology investments at the top, has lost roughly US$ 1 million in 2015 because of the hacker attacks (see more: Phan et al., 2022). Therefore, it is too necessary to conduct an empirical investigation to find out the impact of technology expenditures on the efficiency of operating costs of banks in this country. Furthermore, regardless of constantly calling from government, a lack of empirical examinations is carried out in this researching area. It, in turn, gives us an appropriate opportunity to fill this crucial gap by evaluating the relationship between increasingly investing into technology and operation costs of Vietnamese banks.

To seek a pertinent explanation for our concern, following Phan et al. (2022); Uddin et al. (2020a), we use the natural logarithm of total expenditures on technology (TECH) as the proxy of technological investments of a bank. It is the main explanatory variable and is manually collected from the financial statements of banks consisting of total annual expenditures for software, hardware, data processing and outsourced technical support. Also, following Maudos and Fernández de Guevara (2004), we use average operating costs, which is the ratio of total operating expenses over total assets (OTA), as the dependent variable. Additionally, we respectively control various characteristics of banks, perform multivariate regression analysis and provide a variety of robustness tests including: (i) adding some variables to eliminate the issue of omitted ones, (ii) using alternative measure for dependent variable, (iii) re-performing our baseline with alternative econometric approaches. Generally, our finding suggests that an increase in technological spending will lead banks to reduce effectiveness of operating costs and this result is more evident in large banks than small banks. This empirical evidence is consistent with the recent consideration of Uddin et al. (2020b) and adds to the previous findings of Phan et al. (2022).

Through the study, we hope to contribute to a broad range of financial and technological literature in different ways as follows. First and foremost, our paper provides the first empirical investigation to shed more light on the impact of technological development and digitalization on the banking operation costs, particularly in a developing nation. To the best of our knowledge, most studies on this field almost focus on cross-country settings (Uddin et al., 2020a), developed nations (Beccalli, 2007), and financial market in China (Lee et al., 2021). The recent research of Phan et al. (2022) has certain efforts to gain more insight on the effects of increasingly investing into distribution information and communication technologies on the performance of banks in Vietnam. However, as the studies mentioned, this paper only examinate the aspects of banking performance and instability under effecting of expanding technological expenditures. Hence, our study based on the landscape of an emerging country and exploring the relationship between the technological spending and the cost-effective operation in banks will make a difference in comparison with these previous papers. Moreover, the research is conducted in the response to the call of Frame and White (2004), Uddin et al. (2020), who encourage academics in exploring the effect of

technological and digital development on different aspects of banking operation. Finally, we believe that our finding is too useful for managers, policy-makers and regulators in Vietnam, where has been calling domestic banks for continuously investing into technological innovation, and other countries that have similar financial structure.

The rest of paper is constructed as follows. We review the overall literature in the next section and describe the data and variables in section 3. Section 4 will present our main result and several robustness tests. In section 5, we state both the practical and theoretical implications. The last section is to conclude our finding.

2. Related Literature

In digital era, investing continuously into technology and adopting digitalized progress become an essential part of business strategies of banks. This strategy is an unavoidable tendency in current time and even in coming future. Surprisingly, but, there is an absence of empirical studies carried out on this field due to a lack of available information in financial sector compared to other industries (Frame & White, 2004). Regardless of these obstacles, there are certain attempts to find out the impact of technological and digital development on banking activities and it seems that this effect brings both advantages and disadvantages for banks (Lee et al., 2021).

Under positive aspect, having a huge number of studies has highlighted an integral role of using technology in operating a bank. For instance, Chohan et al. (2022) show that digital adoption helps banks to enhance the loyalty of their own customers due to increasing convenience, satisfaction and trust when doing payments by platform applications. Thus, it contributes to increase their market share and supports the operation of banks. The empirical evidence of Phan et al. (2022) indicates that an increase in investing into distribution information and communication technologies has had the positive effect on banking performance in Vietnam, especially non-interest incomes of banks. Some previous studies also present similar consideration. Accordingly, financial innovation fueled by technology and digitalization provides important opportunities for traditional banks in building diversification strategy because it strengthens banks' ability in offering new products and services at the competitive cost (Berger, 2003). At the same time, it also improves the effectiveness of allocating financial resource (Houston et al., 2010). Relying on delivery strategies, Jayawardhena and Foley (2000) argue that technological development has created advantages in reducing the cost-savings, increasing customer base and growing non-core activities for modern banks. For example, by using cashless payment applications, these banks can provide banking products and services at the cheaper price than other physical channels. Also, based on available data of customer behaviors, banks can also capture quickly new trends of consumption and develop pertinent products to reach new clients. Some studies in non-finance industry have demonstrated this bright aspect. Alzyadat and Almuslamani (2021) find that technology plays a vital role in fostering the growth of distribution sector. Similarly, Lakhwani et al. (2020) consider that the productivity of a firm has an association with rapid changes in technological evolution. These arguments advocate the bright side of technological and digital development and increasingly spending on digitalization and technology will improve the efficiency of operating costs of banks. We identify this investment channel as *the "creative innovation" hypothesis*.

For negative aspect, having a variety of studies warns about threats originating from technological and digitalized adoption in banking sphere. The typical example is the research of Uddin et al. (2020b), who consider that banks have been facing the dilemma situation in digital era with fast changes in technology. To survive in financial market becoming fiercer competition due to entering into shadow-banking of new competitors namely Fintech, banks have few choices but to spending more on digital technology regardless of these investments are really effective. In addition, cyber-security breaches usually appear despites IT infrastructure and equipment are often enhanced and strengthened by banks' investments into technological innovation. The main reason is that the source of cyber-security is usually created by behaviors of human (Eling & Wirfs, 2019). Therefore, these expenditures may make banks increase operation costs and financial performance will be affected adversely. In recent study, the empirical result of Uddin et al. (2020a) indicates that after reaching a limited threshold, spending one dollar on technology will lead banks to face the instability risk. In similar way, Beccalli (2007) shows that technological expenditures have negative association with profitability of banks in Europe. These arguments support the dark side of technological and digital development and accelerating investments into technological innovation will not help banks to enhance the efficiency of operating costs. We identify this investment channel as *the "destructive innovation" hypothesis*.

Taken together, we build the hypotheses as follows:

H1: Increasingly spending on digital technology will lead banks to reduce the efficiency of operation costs.

H2: Continuously investing into digital technology will help banks to enhance the effectiveness of operating costs.

By discovering the relationship between technological and digital investments and the efficiency of operating costs,

our study provides the first empirical evidence to clear the concerns of Uddin et al. (2020b), who warn that an increase in technological expenditures make banks rise operation costs even though it may help banks to strengthen effectiveness in business operation that the recent paper of Phan et al. (2022) has illustrated.

3. Data and Variables

As we mentioned above, the available data is relatively scarce in banking market, especially in emerging countries. In fact, we manually collect the data of Vietnamese commercial banks from audited financial statements on their own website. But we only achieve related information of 12 banks with the period spanning from 2011 to 2020.

In next stage, according to Phan et al. (2022); Uddin et al. (2020a), we use the (natural logarithm) total investments in distribution information and communication technologies (TECH) as the primary explanatory variable, which is the total annual expenses of software, hardware, data processing, outsourced technical support in the notes to the financial statements. For dependent variable, following Maudos and Fernández de Guevara (2004), we use the average operating costs, which is the ratio of total operating expenses over total assets (OTA). At the same time, we also control various fundamental characteristics of banks consisting of the (natural logarithm) total assets (ASSET), the capital ratio (CAPR), the ratio of total income before taxes, provisions recognized in income over gross total assets (EBLTA) and the loan loss reserve ratio (LLR). These control variables are largely used in the financial literature (see more: Phan et al., 2022; Tran, Nguyen, & Lu, 2021).

Our dataset includes around 120 observations for 12 banks. All variables are winsorized at 1% level on the top and bottom of their distribution to mitigate the effect of outliers. The table 1 describes the definition of variables, and the table 2 presents the descriptive statistics (Panel A) as well as the correlation matrix (Panel B).

Table 1: Variables Definitions

Variables	Definitions
TECH	The natural logarithm of total technology expenditures
OTA	The ratio of total operating expenses to total assets
EXPENSE	The ratio of total operating expenses to total operating income before provisions and taxes
ASSET	The natural logarithm of gross total assets
CAPR	Book value of equity over gross total assets
LLR	The loan loss reserve ratio
EBLTA	The ratio of total income before taxes, provisions recognized in income over gross total assets
STATE	A dummy variable equal one if the commercial bank is owned by the state and equal 0 otherwise
GDP	The annual GDP growth of Vietnam
IFL	The annual inflation rate in Vietnam

This table presents definitions of all main variables used in the analysis.

Table 2: Summary Statistics

Panel A: Variables descriptive statistics

VARIABLES	(1)	(2)	(3)	(4)	(5)
	N	mean	sd	min	max
TECH	119	24.23	1.548	20.01	27.45
OTA	120	0.0169	0.00475	0.00944	0.0301
EXPENSE	120	0.565	0.236	0.306	1.572
GDP	120	0.0596	0.0118	0.0291	0.0708
IFL	120	0.0532	0.0510	0.00187	0.187
CAPR	120	0.0818	0.0299	0.0415	0.185
ASSET	120	33.02	1.085	30.55	34.94
LLR	120	-0.0259	0.0691	-0.323	0.0220
EBLTA	120	0.0171	0.00889	0.00166	0.0419

Panel B: Correlation matrix (pairwise)
Pairwise correlations

Variables	(OTA)	(TECHINVEST)	(SIZE)	(CAPITAL)	(EBLTA)	(LLR)
OTA	1.000					
TECH	-0.052	1.000				
	(0.576)					
ASSET	-0.429*	0.688*	1.000			
	(0.000)	(0.000)				
CAPR	0.559*	-0.206*	-0.529*	1.000		
	(0.000)	(0.025)	(0.000)			
EBLTA	0.137	0.429*	0.377*	0.324*	1.000	
	(0.135)	(0.000)	(0.000)	(0.000)		
LLR	0.104	0.292*	0.295*	0.063	0.445*	1.000
	(0.260)	(0.001)	(0.001)	(0.497)	(0.000)	

*** p<0.01, ** p<0.05, * p<0.1*

These tables depict summary statistics and correlation matrix for the main sample of Vietnamese commercial banks used in the analysis. All variables are winsorized at 1% and 99% levels of their distribution to reduce the effects of outliers

4. The Relationship Between an Increase in Spending on Distribution Information and Communication Technologies and the Cost-Efficiency of Banking Operation

4.1. Main Result

To shed more light on our key concern, we employ the multivariate regression analysis to investigate how investing into digital technology affects operation costs of banks after controlling other control variables. Our main baseline model is as follows:

$$COST_{it} = \alpha + TECH_{it} + Z_{it} + \theta_t + \varepsilon_{it} \quad (1)$$

Where, $COST_{it}$ is the measure of operating costs of bank i at time t (OTA). In addition, we use the natural logarithm of TECH as the key explanatory proxy in our investigation. In robustness tests, we use alternative measure for operation costs. Z_{it} is the vector of control variables consisting of ASSET, CAPR, EBLTA and LLR. We obtain time-fixed effects, θ_t, to control for the macroeconomic conditions, common across banks. ε_{it} is the error term.

Our main result is presented in table 3. We use ordinary least squares regression and fixed-effects estimator in Model (1)-(3) and Model (4)-(6) respectively. In first stage, we perform our baseline model in Model (1). The evidence shows that the coefficient of our key independent variable (OTA) is positive and statistically significant at the 1% level. Particularly, increasing one standard deviation of TECH and holding all other equals will result a rise of OTA of 0.15 bps (i.e., the coefficient of TECH, 0.000985, times the standard deviation of TECH, 1.548). It is clear that increasingly investing into distribution information and communication technologies may make banks drain the cost-effective operation, but this impact is relatively modest.

Because having some commercial banks are owned by the state in the sample, we create a dummy variable (STATE), which equals one if a bank is state-owned bank and equals 0 otherwise. To evaluate the effect of these banks on our result, we add the STATE variable into the baseline model in Model (2). Our finding remains unchanged in which the coefficient of the dummy variable is negative and statistically significant at the 10% level. As Frame and White (2004) indicate that macroeconomic conditions may affect the technological progress in financial industry, we continue to perform our baseline model by adding some macroeconomic variables including the annual growth of GDP (GDP) and the annual inflation ratio (IFL) into this model in Model (3). The main result is similar to our previous finding but the magnitude of the TECH's effect is relatively larger.

Because Phan et al. (2022) consider that using the fixed-effects estimator will help to take into account the possible impact of time on the regression result. Therefore, to further strengthen our finding, we re-estimate Model (1)-(3) by using this approach in Model (4)-(6). All results in these models are similar to our previous estimations. In particular, the coefficient of TECH is positive and statistically significant at the 5% level in Model (4) and that at the 1% in the rest of models.

Overall, our regression analysis shows that operation costs would be higher in banks that engage more in technology expenditures. In other words, banks face the risk of ineffectiveness of operating costs when they strongly expand into technological expenditures. The result re-affirms the recent concerns of Uddin et al. (2020b).

Table 3: Baseline Multivariate Analysis

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Ols			Fixed-effect		
	Baseline model	Additional Dummy variable	Additional Macro variables	Baseline model	Additional Dummy variable	Additional Macro variables
TECH	0.000985***	0.000889***	0.00110***	0.000614**	0.000619***	0.000705***
	(0.000321)	(0.000321)	(0.000296)	(0.000242)	(0.000239)	(0.000177)
ASSET	-0.00229***	-0.00157**	-0.00304***	-0.00145	-0.00118	-0.00336***
	(0.000512)	(0.000717)	(0.000447)	(0.000944)	(0.00112)	(0.000643)
CAPR	0.0525***	0.0570***	0.0423**	0.0533**	0.0541**	0.0362
	(0.0190)	(0.0199)	(0.0182)	(0.0223)	(0.0230)	(0.0236)
EBLTA	0.0175	0.00462	0.0563	0.0330	0.0305	0.119
	(0.0604)	(0.0608)	(0.0596)	(0.0902)	(0.0898)	(0.0986)
LLR	0.00884*	0.00879*	0.0143**	0.00768*	0.00812**	0.0134***
	(0.00503)	(0.00491)	(0.00551)	(0.00400)	(0.00406)	(0.00416)
GDP			0.0366			0.0355*
			(0.0274)			(0.0190)
IFL			-0.0232***			-0.0264***
			(0.00860)			(0.00762)
STATE		-0.00184*			-0.00228	
		(0.00105)			(0.00227)	
Constant	0.0643***	0.0432**	0.0858***	0.0453	0.0368	0.105***
	(0.0160)	(0.0216)	(0.0152)	(0.0297)	(0.0349)	(0.0220)
Observations	119	119	119	119	119	119
Number of BANK	12	12	12	12	12	12
R-squared	0.405	0.419	0.456	0.3061	0.3074	0.4026

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The table depicts the regression estimations of the main relationship between an increase in spending on distribution information and communication technologies and the cost-effectiveness of banking operation. All variables are winsorized at 1% and 99% levels of their distribution to reduce the effects of outliers. The asterisks ***, **, * denote significance at the 1%, 5%, and 10% level respectively. The period of sample spans from 2011 to 2020.

4.2. Alternative Measure and Robustness Tests

To further ensure our finding, we provide some robustness tests in this section. As noted by Beccalli (2007) and Phan et al. (2022), banks need a certain period to absorb new technologies into their business management. Thus, we first re-run Model (1)-(3) in table 3 in which the main independent variable is lagged one period. The results described in Model (1)-(3) of table 4 consider that all coefficients in these models have statistically significant at the 5% level in Model (1), Model (3) and at the 10% level in Model (2). It means that there is the existence of a positive relationship between technological spending and ineffective operation costs. Again, the result affirms our finding.

In the rest of models, we continue to re-conduct our baseline model by using alternative measure for the dependent variable. Following Phan et al. (2022), we use the ratio of total operating expenses to total operating income before provisions and taxes (EXPENSE) as the alternative measure for OTA. First, we re-run our baseline model in Model (4) of table 4. The result shows that even though the magnitude of coefficient on TECH is relatively larger in comparison with the previous finding, it is only statistically significant at the 10% level. In Model (5), we perform our baseline model with adding the macroeconomic variables (GDP and IFL). The result in this model is consistent with that in Model (4).

In brief, our evidence continues to show the linear relationship between enlarging more investments into technologies and reducing effectiveness of operation costs in banks. This evidence re-affirms our main result presented above.

Table 4: Alternative measures and robustness tests

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Y=OTA			Y=EXPENSE	
	Baseline model	Additional Dummy variable	Additional Macro variables	Baseline model	Additional Macro variables
L.TECH	0.000684**	0.000616*	0.000755**		
	(0.000334)	(0.000330)	(0.000348)		
TECH				0.0153*	0.0149*
				(0.00888)	(0.00878)
ASSET	-0.00276***	-0.00197***	-0.00284***	-0.0182	-0.0221
	(0.000521)	(0.000742)	(0.000519)	(0.0194)	(0.0227)
CAPR	0.0457**	0.0514**	0.0484**	1.934***	1.828**
	(0.0192)	(0.0206)	(0.0189)	(0.724)	(0.772)
EBLTA	0.0840	0.0600	0.0816	-18.62***	-18.45***
	(0.0609)	(0.0625)	(0.0605)	(3.403)	(3.634)
LLR	0.0110*	0.0108**	0.0116**	0.00985	0.0462
	(0.00559)	(0.00537)	(0.00547)	(0.193)	(0.191)
GDP			0.0363		-0.896
			(0.0285)		(0.954)
IFL			-0.00887		-0.102
			(0.0175)		(0.230)
STATE		-0.00194*			
		(0.00111)			
Constant	0.0870***	0.0629***	0.0861***	0.949	1.153*
	(0.0169)	(0.0233)	(0.0164)	(0.579)	(0.672)
Observations	107	107	107	119	119
R-squared	0.471	0.485	0.480	0.498	0.501

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The table below describes the regression estimations of our main concern in which from Model (1) to Model (3) the primary explanatory variable is lagged one year, and we use alternative measure for this variable in Model (4)-(5). All variables are winsorized at 1% and 99% levels of their distribution to reduce the effects of outliers. The asterisks ***, **, * denote significance at the 1%, 5%, and 10% level respectively. The period spans from 2011 to 2020.

4.3. GMM Regression

As noted by Arellano and Honoré (2001), using OLS method will lead regression result to be biased estimation. Therefore, we re-test our finding by approaching the dynamic system GMM, which is seen as the tool in mitigating potentially correct endogeneity, heteroscedasticity, autocorrelation issues and correlation between all independent variables (Arellano & Bond, 1991; Blundell & Bond, 1998). Table 5 depicts our result.

We start with re-performing our baseline model by using GMM approach in Model (1). The coefficient on TECH has positive association with OTA and stands at the 1% level of statistical significance. Again, the result continues to remain unchanged in comparison with our previous finding. It reflects the positive relationship between technological investment expansion and reducing the efficiency of operating costs.

In Model (3) and Model (4), we respectively add the STATE dummy variable and the macroeconomic variables into the baseline model. Overall, the coefficient on TECH in these models presents similar result to that in Model (1) but to that in Model (3) only stands at the 1% level of statistical significance. Again, the empirical evidence continues to prove our previous finding that TECH is associated with decreasing effectiveness of operation costs.

Table 5: Approaching GMM regression

	(1)	(2)	(3)
	Gmm		
VARIABLES	Baseline model	Additional Dummy variable	Additional Macro variables
L.OTA	-0.0228	-0.0992	0.0242
	(0.213)	(0.412)	(0.243)
TECH	0.000607***	0.000647*	0.000746***
	(0.000211)	(0.000392)	(0.000161)
ASSET	-0.00271***	-0.00269***	-0.00303***
	(0.000357)	(0.000740)	(0.000616)
CAPR	0.0643**	0.0706***	0.0332
	(0.0257)	(0.0259)	(0.0230)
EBLTA	0.0318	0.0179	0.0716
	(0.0482)	(0.0480)	(0.0565)
LLR	0.0153***	0.0160***	0.0130***
	(0.00505)	(0.00521)	(0.00501)
GDP			0.0415***
			(0.0143)
IFL			-0.00599
			(0.00985)
STATE		-0.000688	
		(0.00249)	
Constant	0.0867***	0.0866***	0.0926***
	(0.0132)	(0.0203)	(0.0228)
AR(2)	0.539	0.551	0.475
Wald chi2	3116.07	2043.18	9483.80
Prob > chi2	0.000	0.000	0.000
Observations	107	107	107
Number of BANK	12	12	12

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The table below shows our result in which we approach the dynamic panel of system GMM method to test further our previous finding. All variables are winsorized at 1% and 99% levels of their distribution to reduce the effects of outliers. The asterisks ***, **, * denote significance at the 1%, 5%, and 10% level respectively. The sample period spans from 2011 to 2019.

4.5. The Role of Bank Size

This section will find out the role of bank size in effecting on our finding. Following Phan et al. (2022); Uddin et al. (2020a), we divide the sample into two groups consisting of large and small banks. Accordingly, large banks are ones having total assets above the median value and by contrast, small banks are those having total assets below the median value. The regression results are depicted in table 6.

We employ the baseline model with large banks and small ones in Model (1)-(2) and Model (3)-(4) respectively. For each sample, we first use OTA and then take EXPENSE as dependent variable. In general, all coefficients in all models are positive, however those are statistically significant in large banks alone. Particularly, the level of significance is at 1% and 5% in Model (1) and Model (2) respectively. These regression results show that the adverse impact of expanding technological investments on efficiency of operation costs is presented more evident in large banks than in small banks.

Table 6: The effect of bank size

	(1)	(2)	(3)	(4)
	Large banks		Small banks	
VARIABLES	Y=OTA	Y=EXPENSE	Y=OTA	Y=EXPENSE
TECH	0.00133***	0.0277**	0.000729	0.000895
	(0.000421)	(0.0120)	(0.000507)	(0.0131)

ASSET	-0.00383***	-0.0622***	-0.000855	0.0729
	(0.000769)	(0.0176)	(0.00117)	(0.0583)
CAPR	-0.000570	1.026	0.0930***	2.794**
	(0.0232)	(0.873)	(0.0262)	(1.315)
EBLTA	0.145*	-11.22***	-0.0519	-25.02***
	(0.0800)	(2.468)	(0.0953)	(5.677)
LLR	-0.0111	-0.795***	0.00929*	0.149
	(0.00688)	(0.203)	(0.00489)	(0.210)
Constant	0.109***	2.023***	0.0212	-1.624
	(0.0271)	(0.605)	(0.0354)	(1.806)
Observations	60	60	59	59
R-squared	0.462	0.513	0.375	0.438

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The table reports the result according to the sample divided into two groups (large and small banks) based on the median value of total assets. All variables are winsorized at 1% and 99% levels of their distribution to reduce the effects of outliers. The asterisks ***, **, * denote significance at the 1%, 5%, and 10% level respectively. The period spans from 2011 to 2020.

5. Research Implication

5.1 Practical Implication

From the finding portrayed above, our study has had both the practical implications as well as the theoretical implications. For the former, we suggest a variety of implications for regulators and managers in banking sphere in Vietnam and countries having the similar financial structure as follows.

First and foremost, although continuously expanding investments into distribution information and communication technologies is seen as the unavoidable trend in the digital era in banking sector, our empirical evidence implies that managers in banks should carefully consider these expenditures because these costs might raise the adverse impact on the cost-effective operation. At the same time, this unexpected result is clearer in big banks compared to small ones, thus business strategies of large banks should be re-evaluated the effectiveness of investing in technological development before re-constructing pertinently new strategies in coming time.

Furthermore, to minimize the negative influence driven from expanding more into IT infrastructure, we also suggest that managers in banks have to identify the optimal threshold for investing in technologies in the future. With that in mind, one of the feasible measures to tackle this vital issue is that banks, specifically in emerging nations, should disclose more information related to technological and digital spending. Only based on this available information, analysts, academics and stakeholders can build appropriately analysis models and imply useful suggestions.

In addition, since the absence of disclosure about the costs related to spending on technologies, regulators should have to establish basic rules and regulations of disclosing this information in the standard database in banking system. It not only helps external investors understand real situation of enlarging technology investments of a bank, but also triggers researchers to find out various aspects of the effects of technological development and digitalization on banking operation. Moreover, although Vietnam is at the developing stage on the technological path, policy-makers and regulators need to prepare proactive measures to deal with problems related to cyber risk that Vietnamese banks have undergone (see the typical example in the introduction section). For instance, establishing guidelines of cybersecurity management is one of necessary steps to navigate and enhance the awareness of local banks. With an ambitious target in coming future as mentioned in section 1, a lack of management frameworks for cyber risk may make hazardous issues of banking operation in this country.

5.2 Theoretical Implication

For the theoretical aspect, our empirical evidence also suggests some main implications as follows. First, our study provides one of the first empirical results to shed more light on the adverse relationship between the technology investments and cost-effective operation in banking sphere. Thus, this paper re-affirms the recent concerns about the dilemma situation of traditional banks, who have fewer choices but to increasingly investing in technological development to survive in the fierce competition due to the emergence of newcomers – Fintech firms – as some studies have stated, such as Uddin et al. (2020a); Uddin et al. (2020b); Vives (2019).

Second, as Frame and White (2004) claim that the main reason of lacking empirical analysis to explore the possible

influences of technological development on banking operation is the scarcity of the available data in banks in comparison with other industries. Therefore, this study is to help researchers have gained more insights into this 'wild field', specifically in an emerging country, where the related data is really scarce. Furthermore, some previous empirical studies almost focus on cross-country sample (Uddin et al., 2020), developed countries (Beccalli, 2007), or Chinese market (Lee et al., 2021), thus taking a backdrop of a developing country has created a difference for our finding. Also, by discovering cost-effective aspect, our evidence may be good compliment to the previous findings of Beccalli (2007), Phan et al. (2022), and Uddin et al. (2020) who solely emphasize the banking performance and stability of banks.

Eventually, because our finding shows that expanding into distribution information and communication technologies has a relatively negative association with cost-effectiveness of operating costs in big banks. Hence, the result re-confirms the argument of Scherer (2001), who suggests that large corporations (and even monopoly firms) have less incentives in enlarging innovation in an effective way that the author calls "quiet life" in these companies. In this vein, this finding again spurs banking academics to point out the optimal threshold for technology spending in coming future as we stated above. Also, exploring different aspects and separating these related costs into software and hardware may play a vital role in adding empirical evidence to our analysis.

6. Conclusions

Our study provides the empirical evidence to add more insights to the research of Uddin et al. (2020b), who warn that in the digital era, banks have to investing into technology to battle against cyber-security breaches and emergence of Fintech firms and thus these expenditures may lead banks to increase operating costs. Our finding also sheds more light on the other aspects of the effect of technological and digital development on banking sector that the recent study of Phan et al. (2022) has highlighted. Particularly, we give the consistent evidence about the expansion of spending on distribution information and communication technologies has negative impact on the efficiency of operation costs of banks. Our result survives through various robustness tests performed. At the same time, this adverse effect is quite clear in large banks compared to small ones. We strongly believe that these empirical results are useful for both managers of banks and policy-makers, especially in Vietnam where regulators always call for constantly investing into technological innovation and IT infrastructure in banks. Based on this finding, we suggest that Vietnamese banks should carefully consider technological expenditures before building business strategies because these expenditures may rise the probability of reducing efficiency of operation costs.

Even though we try to seek a pertinent answer to explore the impact of technological and digital development on banking operation, our study also maintains some certain drawbacks that future papers can fill these gaps. For example, one of the most important aspects needing to be considered is that the relationship between technology development and banking intermediary activities. Another compelling example is that the expansion of technology spending in ASEAN banking system needs to be investigated because this area is seen as one of places having strongly technology development and playing a crucial role in recent years. Therefore, through the study, we once again hope to pay the way for many studies on this field carried out in coming future.

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